



RADAR REFLECTIVITY EXPERIMENT

Measurements for volcano and earthquake monitoring

Abstract

This experiment is a further continuation of the research done by Dr. Friedemann Freund, Dr. Robert Dahlgren, and Colin Williams in 2009. This experiment showed a ~5% increase in radar reflectivity on the cold surface of a rock when a sub-volume of the rock heated. Before large earthquakes and volcanic eruptions the earth sends out signals. Increased stress and temperature activates electronic charge carriers within the Earth's crust.

This experiment involves stressing large granite boulders with hydraulic cement inserted into the rock. Many tools will be used in monitoring the rock. Each one of these monitoring devices will observe changes as a function of time during build-up of stress prior to rock fracture.

Introduction & Theory

Before earthquakes and volcanic activity occur increasing stress and rising temperatures activate mobile electronic charge carriers in rocks deep in the Earth's crust. These charge carriers are known as positive holes and are remarkable in their ability to diffuse out of rocks. When the positive holes arrive at the Earth's surface they lead to a range of processes that can be detected remotely by satellite assets.

We plan to conduct lab experiments measuring the effects on 2-4 ton rocks. Using hydraulic cement inserted into the rocks over time will generate large amounts of pressure to cleave the rock. During this build up of pressure many analytical tools will be used.

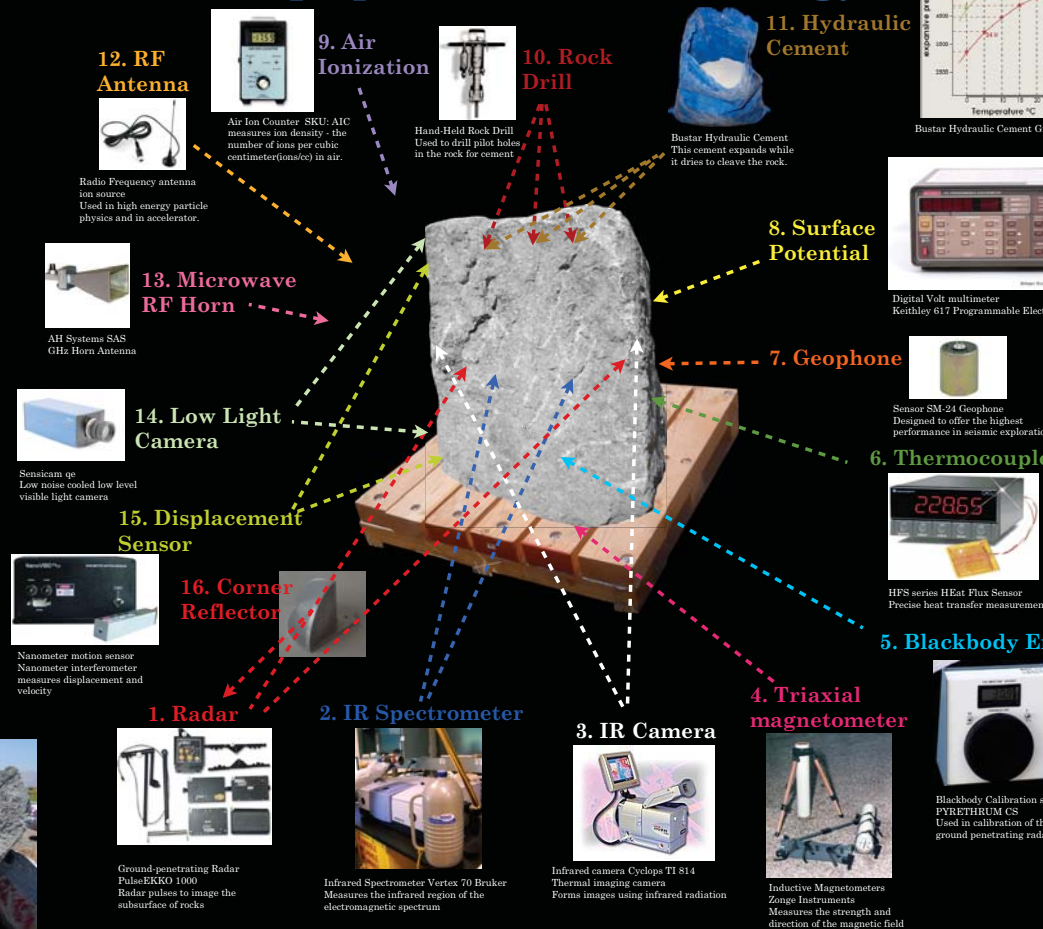
Left to right - 3 rocks prepped for experiment and 2.2 ton rock and Garrett prior to transport



Garrett J. Benjamin
California State University Fresno
Science Teacher and Researcher (STAR) Program
Dr. Friedemann T. Freund
Principal Investigator at the SETI Institute
Senior Scientist at the NASA Ames Research Center



Equipment & Methodology



Results & Conclusion

Currently, there are no results to report. The experimental set up and guidelines are still being worked out with NASA officials and the Safety committees at NASA Ames Research Center. We however predict that our results will show similarities to the 2009 pilot study. This pilot study using 1.2 GHz radar showed a ~5% increase in radar reflectivity off a smooth gabbro surface. The reason for this is believed to be because of the large numbers of positive holes arrive at the surface. A ~5% change in the radar reflectivity could easily be observed in synthetic aperture radar (SAR) images. Such changes could indicate a run up of stress leading to fault line failure.

Future Work

The long-term goal is to determine whether changes in radar reflectivity presage earthquakes or volcanic activity. Based on preliminary findings radar reflectivity holds promise to be an indicator for pre-earthquake and volcanic activity. This concept will lay the foundation for further work to apply this concept to satellite missions with radar capabilities. Our project has the potential of revolutionizing NASA's Natural Disasters Plan and this country's approach to national and global challenges posed by earthquakes and volcanoes.

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Plastic Pallets used for a platform in the experiment